Background Report Reference

AP-42 Section Number: 8.13

Background Chapter: 4

Reference Number: 8

Title: Compliance Test Report: Amoco Oil Company

Southwestern Laboratories, Inc.

May 1989

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R7-232
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7/14/89

SULFUR DIOXIDE COMPLIANCE EMISSIONS TEST OF THE SULFUR RECOVERY UNIT AMOCO OIL COMPANY

AMOCO OIL COMPANY
TEXAS CITY, TEXAS

May 4, 1989

SwL Customer No. 2-0470-20
SwL Project No. 54-8905-253

This study was conducted by the
Environmental/Analytical Services Division
of Southwestern Laboratories, Inc.
Houston, Texas

SwL **SOUTHWESTERN LABORATORIES**

Materials, environmental and geotechnical engineering, nondestructive, metallurgical and analytical services

222 Cavalcade St. • P.O. Box 8768, Houston, Texas 77249 • 713/692-9151

June 12, 1989

Re: SOx Emissions Sampling of SRU
Texas City, Texas
SwL Customer No. 2-0470-20
SwL Project No. 54-8905-253

AMOCO OIL COMPANY
P. O. Box 401
Texas City, Texas 77590

Attention: Mr. Watson Dupont

Gentlemen:

In accordance with our agreement, Southwestern Laboratories, Inc. hereby transmits our test report covering the testing performed at your Texas City, Texas facility. Field sampling was conducted May 4, 1989.

This report is for the exclusive use of AMOCO OIL COMPANY, and except for submission to regulatory agencies, the use of our name relative to the report must receive prior written approval.

It has been a pleasure working with you and your personnel at your Texas City, Texas facility once again. Please let us know if we may be of further service, or if you have any questions concerning this report.

Sincerely,

SOUTHWESTERN LABORATORIES, INC.

Phillip W. Yokley

Phillip W. Yokley
Project Manager

Russell J. DiRaimo, P.E.
Manager
Environmental/Analytical Services

RJD:pm

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INTRODUCTION

Field sampling was conducted May 4, 1989 to determine sulfur dioxide (SO_2) emissions from the Sulfur Recovery Unit (SRU) stack at the Texas City, Texas facility of AMOCO OIL COMPANY (AMOCO). Sampling was performed by personnel of Southwestern Laboratories (SwL) Environmental/Analytical Services (EAS) Division. Personnel involved in the sampling program included: Mr. Watson Dupont and Ms. Sue Edrozo of AMOCO OIL COMPANY, and Messrs. Phillip Yokley, Robbie Daughtry, and Doug Belcher of Southwestern Laboratories, Inc. (SwL).

Sampling was conducted on the SRU in accordance with requirements contained in the Texas Air Control Board (TACB) Permit No. R-8811.

RESULTS

Results calculated in accordance with EPA and TACB procedures are shown in the Tables section of this report.

Pertinent test data are described below:

Parameter	Average Emissions	Permit Allowable	% of Allowable
SO_2	108 ppm (dry, O_2 free)	250 ppm (dry, O_2 free)	43.2
SO_2	26.29 lb/hr	161.9 lb/hr	16.2
O_2	2.1%	---	--
Flow	1,624,786 dscf/hr	---	--

Sulfur production was 406 long tons/day for the May 4, 1989 test period. Three trains were operating through one SCOT tail gas unit

PROCEDURES

Sampling equipment and procedures were in conformity, except where noted, with Reference Methods 1, 2, 3, 4 and 6 of the EPA (as described in 40 CFR 60, "Standards of Performance for New Stationary Sources", Appendix A - Reference Methods) and Chapter 6 of the TACB Compliance Sampling Manual (revised January, 1983). A pretest conference was held at AMOCO on April 18, 1989 to discuss test methodologies. TACB, AMOCO and SwL representatives were present at this meeting. All testing was conducted in accordance with agreements reached at this meeting.

Sample and Velocity Traverses - Method 1

The SRU exhaust stack was 7.5 feet internal diameter (ID). Two (2) four-inch flanged sample ports, 90 degrees apart, were present. Upstream distance from flow disturbance (top of stack) to sample ports (Distance A) was in excess of 2.0 stack diameters. Downstream distance from flow disturbance (top of entry duct) to sample ports (Distance B) was 81.25 feet (in excess of 8.0 stack diameters). It was determined that a

twelve (12) point traverse for velocity measurements (six points from each port) would be appropriate.

Determination of Stack Gas Velocity and Volumetric Flow Rate - Method 2

Stack gas velocity was measured with an "S" type pitot tube constructed in accordance with "Proper Pitot Tube Sampling Nozzle Configuration", as specified in the Environmental Protection Agency, "Standards of Performance for New Stationary Sources - Revision to Reference Methods 1-8 (FR Thursday, August 18, 1977, Part II)". The pitot tube coefficient value was determined by wind tunnel calibration. Temperature measurements were determined by means of a calibrated digital thermometer with a Type "K" thermocouple. A ten (10) point velocity-stack temperature traverse was obtained for each pollutant test run. A ten (10) point traverse became necessary due to limited platform space and obstructions which prevented the use of a longer sample probe. Therefore, the last point on each traverse was unattainable. This criteria was discussed and approved at the Pretest Conference.

Leak checks of the pitot system were performed before and after the velocity tests. In addition, cyclonic flow checks were performed to ensure that the flow was parallel to the stack wall.

Gas Analysis and Molecular Weight Determination - Method 3

Integrated samples were taken during each SOx sample run and analyzed for CO_2 and O_2 by use of a standard Orsat analyzer. N_2 was determined by difference. Analysis was performed at the field site immediately after sampling. This data was utilized in stack gas molecular weight determinations used in flow rate calculations and also for oxygen correction purposes (SO_2 data) in accordance with requirements in 40 CFR 60, Subpart J.

Determination of Moisture Content in Stack Gases - Method 4

Moisture content of the stack gas was determined by gravimetric analysis of the impinger catch from each SOx sample run.

Determination of Sulfur Oxides in Stack Gas - EPA Method 6, and TACB Standard Method - Chapter 6

A sampling train similar to the one described in APTD-0581, complete with 8 foot long, stainless steel lined probe, was used to collect SOx samples (See Figure #2). The first impinger contained 100 ml of 80% isopropanol, the second and third impingers each contained 100 ml of 6% hydrogen peroxide (H_2O_2), and the fourth impinger contained a known weight of silica gel.

Three SO_2 compliance sample runs were obtained May 4, 1989. Each sample run was of thirty (30) minute duration with approximately 11.36 dry standard cubic feet (dscf) of stack gas sampled. Samples were obtained proportionally from the midpoint of the stack, at an approximate sample rate of 0.38 dscf/minute. At the conclusion of each sample run, an ambient air purge of approximately 2 cubic feet was performed, in order to sweep any residual SO_2 contained in the first impinger into the 6% H_2O_2 absorbing solution contained in the second and third impingers.

Prior to and following each sample run, a leak check of the sampling system was performed. After each sample run, all glassware was sealed to prevent contamination of the samples.

SAMPLE RECOVERY

Sulfur Dioxide

Analysis for SO_2 was performed in accordance with TACB procedures (as contained in Chapter 29, of the TACB's "Laboratory Methods for Determination of Air Pollutants," modified July 24, 1979), employing Alcoholic Barium Perchlorate as the titrant. Calculations and analytical data sheets are included with this report in Item IV, Field and Laboratory Data Sheets.

Oxygen

Stack gas O_2 determinations were made at the field site utilizing an Orsat analyzer.

CUSTODY OF SAMPLES

After completion of tests, each sample was placed in the custody of the technician responsible for analysis. It was his assigned responsibility to ensure that each sample was recorded and correctly analyzed. Analysis of samples was performed at the field site or in Southwestern Laboratories' facilities by Environmental/Analytical Services' personnel. It was the duty of the Department Manager and the Project Manager to answer any procedural queries from the Laboratory Technician. Final responsibility rested with the Department Manager.

QUALITY ASSURANCE

Southwestern Laboratories maintains a strict quality assurance program. Included in this program are: equipment calibration checks such as the meter box gamma check, performed after each field use; balance calibration checks; analytical calibration checks; and calculation checks. Also included in SwL's Quality Assurance program is its participation in the EPA Inter-Laboratory Source Survey for Methods 3, 5, 6 and 7.

SwL personnel also performed a quality assurance verification of the SO_2 analysis employing EPA prepared standards (from SwL's library of standards).

DISCUSSION

All sampling was coordinated with AMOCO personnel to insure that the plant was operating at stable conditions.

Equipment setup and all compliance testing was performed on May 4, 1989. Compliance testing consisted of three (3) thirty minute SOx runs, three (3) thirty minute integrated Tedlar bag samples taken for O_2 analysis, and three (3) velocity-stack temperature traverses.

The limited clearance on the platform caused the test crew to utilize an eight (8) foot probe for velocity measurements, which made the last traverse point on each diameter inaccessible. SwL believes that the data is unbiased due to the low pressure differentials (ΔP) encountered (0.05 to 0.10) and the adequate upstream and downstream distance from flow disturbances (greater than 2.0 and 8.0 respectively). This criteria was discussed and agreed upon at the Pretest Conference. Otherwise, all testing was completed without further incident.

SO_2 emissions were reported two ways. First, to comply with 40 CFR 60, Subpart J (TACB Permit Special Provision

2) the SO_2 emissions were calculated on a ppm, dry basis, corrected to zero % oxygen basis. The SO_2 emissions were also quantitated on a lb/hr emission rate basis, in accordance with the TACB Permit Maximum Allowable Emissions Table.

SUMMARY

The average SO_2 emissions for the three (3) compliance sample runs were 108.0 ppm (dry basis, O_2 free) and 26.3 lb/hr., which represents 43.2% and 16.2% of the stated allowable emissions (250 ppm, dry basis, O_2 free and 161.9 lb/hr). The unit produced 406 long tons per day of sulfur product, with three (3) trains going through one (1) SCOT tail gas unit (operational data provided by AMOCO).

TABLES

TABLE NO. 1

SOURCE IDENTIFICATION

Plant Name: AMOCO OIL COMPANY Phone: (713) 945-1158

Address: P. O. Box 401

City: Texas City State: Texas Zip: 77590

Plant Manager: Mr. L. J. Sandheinrich

Plant Representative: Mr. Watson Dupont

Process or Function: Sulfur Recovery Unit

Source Identification: SRU

Stack or Duct Description: Vertical, circular

Stack Height: Platform Height 95' Stack Diameter: 7' 6"

Stack Temperature: 512°F Percent Moisture: 10.7

Sampling Facilities: Two (2) four-inch flanged ports

Process (Batch or Continuous): Continuous

Normal Operating Capacity:

Operational Status (Sampling Period): 406 long tons/day (3 trains going through 1 scot tail gas unit)

Sampling Parameters: Sulfur Dioxide, Flow, Oxygen

Date Tested: May 4, 1989

Signed: for

Phillip Yokley
SOUTHWESTERN LABORATORIES, INC.

TABLE NO. 2

SUMMARY OF SAMPLING RESULTS - Sulfur Dioxide

AMOCO OIL COMPANY
TEXAS CITY, TEXAS

SwL Project No. 54-8905-253

Run No.	Date 1989	Time Period	Net Time (mins.)	Vm (Std) dscf	SO_2 lb/hr	% of * Allowable	** Oxygen Adjusted SO_2 ppm	% of * Allowable
1	5-4	1206-1236	30	11.366	19.83	12.2	83.27	33.3
2	5-4	1308-1338	30	11.367	29.11	18.0	119.54	47.8
3	5-4	1437-1507	30	11.346	29.93	18.5	121.33	48.5

* SO_2 allowables as per Permit R-8811 are 161.9 lb/hr and 250 ppm, dry and O_2-free

** dry basis, oxygen free

TABLE NO. 3

SUMMARY OF SAMPLING RESULTS - Orsat Analysis

AMOCO OIL COMPANY
TEXAS CITY, TEXAS

SRU
SwL Project No. 54-8905-253

Date 1989	Time Period	Run No.	Orsat Results $\%CO_2$	$\%O_2$	%CO
5-4	1206-1236	1	4.9	2.2	NA
5-4	1308-1338	2	5.0	2.2	NA
5-4	1437-1507	3	5.0	2.0	NA

TABLE NO. 4

SUMMARY OF SAMPLING RESULTS - Flow Data (EPA Parameters)

AMOCO OIL COMPANY
TEXAS CITY, TEXAS

SRU
SwL Project No. 54-8905-253

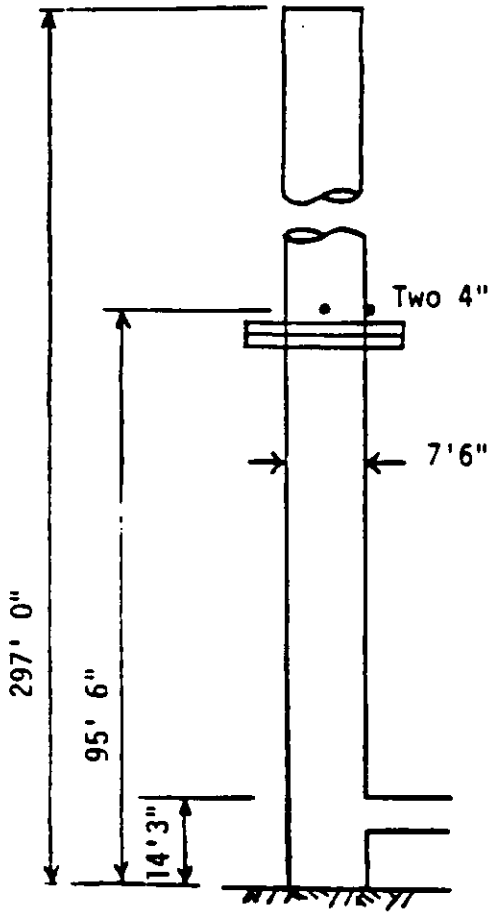
Run No.	Date 1989	Time Period	Ts Stack Temp. °F	Vs Stack Velocity ft/sec	Percent Moisture	ACFM Stack Gas Flow	Qsd Dry Stack Gas Flow dscf/hr
SO_2 Compliance Test							
1	5-4	1206-1236	508	21.17	12.5	56,113.5	1,599,306
2	5-4	1308-1338	515	21.12	9.7	55,987.3	1,635,818
2	5-4	1437-1507	512	21.15	9.9	56,067.6	1,639,235

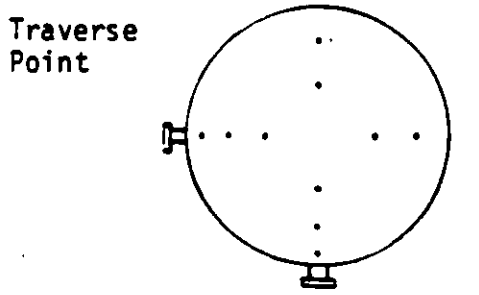
FIGURES

FIGURE NO. 1

AMOCO OIL COMPANY
Texas City, Texas

Sulfur Recovery Unit
SWL Project No. 54-8905-253



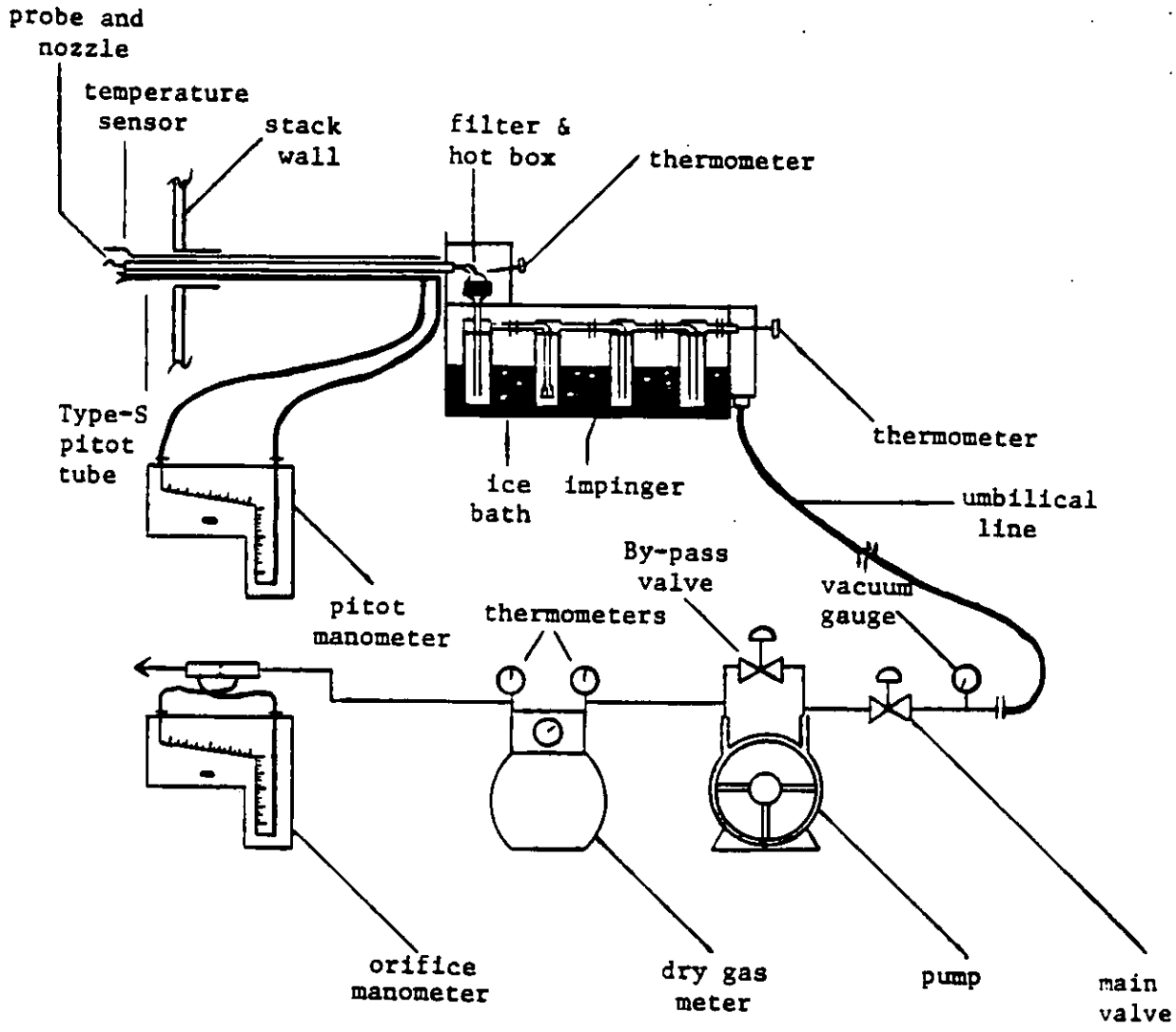


Stack Cross-section

FIGURE # 2

SOUTHWESTERN LABORATORIES
ENVIRONMENTAL ENGINEERING SERVICES DIVISION

SOURCE SAMPLING TRAIN



E.P.A. Method 5 and 6 Source Sampling Train

EES 01/81-15/301

SOUTHWESTERN LABORATORIES

SOUTHWESTERN LABORATORIES
VELOCITY TRAVERSE FIELD DATA

Plant: Amoco Oil Co
Texas City TX.

Date: 5-4-89 Time: _____ Run: 1 2 3

Source Name: _____

Bar. Pres. _____ In. Hg. Stack Pres. _____ In. H_2O

Stack ID 90 Inches Ambient Temp. _____ °F

Port Extensions (Inches) (1) 11½ (2) 11½

Schematic of Stack Cross Section

Point No.	% Dia.	Dist. From Ref. Point (inches)	Run 1 Ts-Stack Temp. °F Ts_1	Run 1 ΔP-Vel. Head inches H_2O ΔP_1	$\sqrt{\Delta P_1}$	Run 2 Ts-Stack Temp. °F Ts_2	Run 2 ΔP-Vel. Head inches H_2O ΔP_2	$\sqrt{\Delta P_2}$	Run 3 Ts-Stack Temp. °F Ts_3	Run 3 ΔP-Vel. Head inches H_2O ΔP_3	$\sqrt{\Delta P_3}$
1	4.4	3.96	340	.05		340	.05		341	.06	
2	14.6	13.14	554	.08		560	.07		551	.08	
3	29.6	26.64	562	.09		563	.10		550	.09	
4	70.4	63.36	553	.10		562	.10		547	.10	
5	85.4	76.86	528	.10		558	.10		559	.10	
6	95.6	86.04	—	—		—	—		—	—	
1			348	.05		349	.06		350	.06	
2			552	.09		550	.07		552	.07	
3			558	.09		560	.10		559	.09	
4			550	.10		560	.10		560	.10	
5			534	.10		548	.10		550	.10	
6			—	—		—	—		—	—	
		Averages:	.2825	508		515	.2835		512	.2902	
			968			975			972		

Avg. Ts°R = $\Sigma \frac{Ts}{N}$ + 460 = Avg. $\sqrt{\Delta P}$ = $\Sigma \frac{\sqrt{\Delta P}}{N}$ =

Vs = 85.49 x Cp x Avg. $\sqrt{\Delta P}$ x $\sqrt{\frac{\text{Avg. Ts}}{\text{MWS} \times Ps}}$ Vs = 85.49 x ( )x( ) x $\sqrt{\quad}$

N = No. of Temp. or ΔP Readings

Probe ID S-13 Temperature ID Omega 37YY0 TC-8-3 Barometer ID N

EFS 01/81-16/400

AMOCO OIL COMPANY -- SULFUR RECOVERY UNIT

Southwestern Laboratories
Environmental Analytical Services Division
Houston, Texas

E.P.A. Method 5 Analytical Data

Run No.	Samp Time (min)	Net Vol. (cu ft)	Avg delta H (in. H2O)	Avg Meter Temp. (F)	Avg Stack Temp. (F)	Avg sq rt delta P (in. H2O)	Meter P Pm (in. Hg)	Stack P Ps (in. Hg)	DGMCF	Cp	As (sq ft)
1	30	11.676	0.5	99	508	0.2895	29.95	29.79	1.0296	0.787	44.179
2	30	11.886	0.5	109	515	0.2895	29.95	29.79	1.0296	0.787	44.179
3	30	11.822	0.5	~~107~~ 106	512	0.2902	29.95	29.79	1.0296	0.787	44.179

Run No.	Tot. H2O Collect (mL)	Orsat Data %CO2	%O2	%N2
1	34.6	4.9	2.2	92.9
2	25.9	5	2.2	92.8
3	26.5	5	2	93

E.P.A. Method 5 Flow Calculations

Run No.	Vm Std. dscf	% H2O	MWSG g/g mole	Vs ft/sec	ACFM	Qsd dcsf/hr
1	11.366	12.53	27.509	21.17	56,113.49	1,599,306.0
2	11.367	~~9.69~~ 9.71	27.833	21.12	55,987.32	1,635,817.5
3	11.346	9.98	27.802	21.15	56,067.56	1,639,234.5

11.367

SOUTHWESTERN LABORATORIES
SOURCE SAMPLING FIELD DATA

PLANT Amoco Orla GP — STACK SRU
DATE 5-4-89 — OPER. SRU — SAMPLE NO. 1 — STACK HEIGHT ____
STACK DIA.(exit) ____ — STACK DIA.(port) ____ — STACK PRESS."H_2O -.06 — BAR.PRESS."Hg 29.91
PROBE NO. 8-B 83 — PTCF .787 — DGMCF 1.0296 — NOZZLE NO. N/A
NOZZLE AREA N/A — FILTER NO. Bypass — SILICA GEL NO. 29 — INITIAL LEAK RATE .010
METER NO. 3 — ΔH @ 1.7899 — BOX NO. E — FINAL LEAK RATE .010
PROCESS DATA Sour/o.sur/Fl — ASSUM. MOIST. ____ — NOM. REF. PT. N/A — PROBE LINER 8'SS

PT	Mins. Clock Time	Ft^3 Dry Gas Meter Reading	In. H_2O ΔP	In. H_2O ΔH	°F Probe Temp.	Dry Gas Meter Temp. °F Inlet	Dry Gas Meter Temp. °F Outlet	In.Hg Gauge Line Vacuum	Temp. °F Box	Temp. °F Ts Stack	Temp. °F Last Imp.	$\sqrt{\Delta P}$
START	1206	234.584		.50		90	92	2½			72	
	1211	236.51				94	92	2½			72	
	1216	238.45				98	94	2½			74	
	1221	240.42				102	96	2½			74	
	1226	242.46				108	102	2½			76	
	1231	244.30				112	104	2½			78	
STOP	1236	246.260										
	Rinse 25' 3 2.50											
	30	11.676		.50		99						
	SAMPLE TIME	NET VOL.		AVG ΔH		AVG METER TEMP				AVG STACK TEMP.°F		AVG $\sqrt{\Delta P}$

$$Vm(Std.) = \frac{11.676\ ft^3}{(Net\ Vol.)} \times \frac{1.0296}{(DGMCF)} \times \frac{528}{559\ Std.T(R)/AMT\ (R)} \times \frac{29.95\ Pm}{29.92\ Std.P} = 11.366\ dscf$$

Ambient Temp. ____ °F Avg.Meter Temp. 559 °R Meter Pressure (Pm) = $\frac{29.91 + .50}{13.6}$ = 29.95 (In. Hg.)

Stack Pressure (Ps) (in Hg.) = $\frac{29.91 + -.16}{13.6}$ = 29.79

ORSAT Run 1
12:06 - 12:36

Thermometer ID Dwg#37440 TC-83 Barometer ID B

EES 01/81-16/401

SOUTHWESTERN LABORATORIES
SOURCE SAMPLING
ANALYTICAL DATA

Plant: AMOCO OIL CO
TEXAS CITY TX.

Box E (A) Run No. 1 Date: 5-4-89

PARTICULATES: Filter No. Bypass

Wt. Filter - Final
Wt. Filter - Tare
Wt. on Filter
Acetone Wash Particulate

Weight Partial Particulate (IMPP) g.

1st Impinger
2nd & 3rd Impinger
Impinger Catch-Total (IMPI) g.

Weight Total Particulate (GPC) g.

MOISTURE:

	Flask 1 (80% DMF)	Flask 2 (6% H_2O_2)	Flask 3
Impinger Wash H_2O Final Weight	153.8	184.9	173.6
Initial Weight	148.1	167.2	167.7
Net Increase	5.7	17.7	5.9

Silica Gel No. 8129
Final Weight 236.0
Initial Weight ~~225~~ 230.7
Net Increase (TG) 5.3 g.

Total Water Collected (TWW) 34.6 ml
Vm (Std) 11.366 dscf

$$\% \text{ Moisture} = \frac{(0.04707 \times TWW) \times 100}{Vm\ (Std) + (0.04707 \times TWW)} = \frac{162.8622}{12.994622} = 12.5\%$$

ORSAT:

Time				
CO_2				
O_2				
CO				

*Converted to ml by dividing by the density of water (1 g/ml)

MOLECULAR WEIGHT: (MWSG) g/g mol

H_2O - .125 x 18 = 2.25
CO_2 - .875 x .0~~99~~ x 44 = 1.886
O_2 - .875 x .022 x 32 = 0.616
CO - ___ x ___ x 28 = ___
N_2 - .875 x .92~~8~~ x 28 = 22.76

MWSG 27.51

SOUTHWESTERN LABORATORIES
SOURCE SAMPLING FIELD DATA

PLANT Amoco Dilco | STACK SRU
DATE 5-4-89 | OPER. JRD | SAMPLE NO. 2 | STACK HEIGHT
STACK DIA.(exit) 90" | STACK DIA.(port) | STACK PRESS."H_2O 1.6 | BAR.PRESS."Hg 29.91
PROBE NO. S-B | PTCF .787 | DGMCF 1.0296 | NOZZLE NO. N/A
NOZZLE AREA N/A | FILTER NO. BYPASS | SILICA GEL NO. 24 | INITIAL LEAK RATE 0.0
METER NO. 3 | ΔH @ 1.7899 | BOX NO. E | FINAL LEAK RATE 0.0
PROCESS DATA SO2/O2 CO2/H2O | ASSUM. MOIST. | NOM. REF. PT. N/A | PROBE LINER SS

Pt	Mins. Clock Time	Ft^3 Dry Gas Meter Reading	In. H_2O ΔP	In. H_2O ΔH	°F Probe Temp.	Dry Gas Meter Temp. °F Inlet	Dry Gas Meter Temp. °F Outlet	In.Hg Gauge Line Vacuum	Temp. °F Box	Temp. °F Ts Stack	Temp. °F Last Imp.	$\sqrt{\Delta P}$
START	1308	248.293		1.50		102	104	4 1/2			78	
	1313	250.126				104	104	4 1/2			78	
	1318	252.25				110	106	4 1/2			78	
	1323	254.23				114	108	4 1/2			76	
	1328	256.20				118	106	4 1/2			76	
	1333	258.19				120	108	4 1/2			76	
STOP	13:38	260.179		↓								
		Purged 2A 32.50										
	30	11.986		1.50		108						
	SAMPLE TIME	NET VOL.		AVG ΔH		AVG METER TEMP				AVG STACK TEMP.°F		AVG $\sqrt{\Delta P}$

$$Vm(Std.) = \frac{11.986\ ft^3}{(Net\ Vol.)} \times \frac{1.0296}{(DGMCF)} \times \frac{528}{560} \frac{Std.T(R)}{AMT\ (R)} \times \frac{29.95\ Pm}{29.92\ Std.P} = 11.367\ dscf$$

Ambient Temp. _____ °F Avg.Meter Temp. _____ °R Meter Pressure (Pm) (In. Hg.) = $\frac{29.91 + .50}{13.6} = 2.995$

Stack Pressure (Ps) (in Hg.) = $\frac{29.91 + -1.6}{13.6} = 29.79$

RUN 2 ORSAT
1308 - 1338

Thermometer ID Doric #37440 TC-8-3 Barometer ID B

SOUTHWESTERN LABORATORIES
SOURCE SAMPLING
ANALYTICAL DATA

Plant: Amoco Oil Co-
Texas City, TX.

Box F(B) Run No. 2 Date: 5-4-89

PARTICULATES: Filter No. Bypass

Wt. Filter - Final _____

Wt. Filter - Tare _____

Wt. on Filter _____

Acetone Wash Particulate _____

Weight Partial Particulate (IMPP) _____ g.

1st Impinger _____

2nd & 3rd Impinger _____

Impinger Catch-Total _____ (IMPI) _____ g.

Weight Total Particulate (GPC) _____ g.

MOISTURE:	80% DSOP Flask 1	6% H_2O_2 Flask 2	Flask 3
Impinger Wash H_2O Final Weight	147.1	288.0	
Initial Weight	148.0	267.9	
Net Increase	-0.9 ✓	20.1 ✓	

Silica Gel No. 24

Final Weight 224.7

Initial Weight 218.0

Net Increase (TG) 6.7 ✓ g.

Total Water Collected (TWW) 25.9 ✓ ml

Vm(Std) 11.367 dscf

$$\% \text{ Moisture} = \frac{(0.04707 \times TWW) \times 100}{Vm(Std) + (0.04707 \times TWW)} = \frac{121.9133}{12.586133} = 9.7\%$$

ORSAT:

Time _____

CO_2				
O_2				
CO				

*Converted to ml by dividing by the density of water (1 g/ml)

MOLECULAR WEIGHT: (MWSG) g/g mol

H_2O .097 x 18 = 1.746

CO_2 .903 x .050 x 44 = 1.986

O_2 .903 x .022 x 32 = 0.63

CO - x - x 28 = —

N_2 .903 x .928 x 28 = 23.4

MWSG 27.83

EES 01/81-16/402B

SOUTHWESTERN LABORATORIES
SOURCE SAMPLING FIELD DATA

PLANT Amoco Oil Co | STACK SEU
DATE 5-4-89 | OPER. JED | SAMPLE NO. 3 | STACK HEIGHT
STACK DIA.(exit) 90" | STACK DIA.(port) | STACK PRESS."H_2O -1.6 | BAR.PRESS."Hg 29.91
PROBE NO. B-B | PTCF .787 | DGMCF 1.0296 | NOZZLE NO. N/A
NOZZLE AREA N/A | FILTER NO. Bypass | SILICA GEL NO. 25 | INITIAL LEAK RATE .010
METER NO. 3 | ΔH @ 1.7899 | BOX NO. E | FINAL LEAK RATE .010
PROCESS DATA Sampling Flow | ASSUM. MOIST. | NOM. REF. PT. N/A | PROBE LINER 8' SS

P	Mins. Clock Time	Ft³ Dry Gas Meter Reading	In. H_2O ΔP	In. H_2O ΔH	°F Probe Temp.	Dry Gas Meter Temp. °F Inlet	Dry Gas Meter Temp. °F Outlet	In.Hg Gauge Line Vacuum	Temp. °F Box	Temp. °F Ts Stack	Temp. °F Last Imp.	$\sqrt{\Delta P}$
Start	1437	262.212		.50		98	100	4			82	
	1442	264.16				102	102	4			78	
	1447	266.17				108	104	4			72	
	1452	268.11				112	106	4			72	
	1457	270.08				118	106	4			72	
	1502	272.04				110	108	4			79	
Stop	1507	274.034		↓								
		Pumped 2ft³ 2.50										
	30	11.822		.50		106.1667 → 106						
	SAMPLE TIME	NET VOL.		AVG ΔH		AVG METER TEMP				AVG STACK TEMP.°F		AVG $\sqrt{\Delta P}$

$V_m(Std.) = \frac{11.822\ ft^3}{(Net\ Vol.)} \times \frac{1.0296}{(DGMCF)} \times \frac{528}{566\ AMT\ (R)} \times \frac{29.95\ Pm}{29.92\ Std.P} = 11.346$ dscf

Ambient Temp. _____ °F Avg.Meter Temp. 566 °R Meter Pressure (Pm) = $\frac{29.91 + .50}{13.6} = 29.95$ (In. Hg.)

Stack Pressure (Ps) (in Hg.) = $29.91 + \frac{-1.6}{13.6} = 29.79$

Run 3 ORSAT
1437-1507

Thermometer ID Dwg #37446 TC-8-3 Barometer ID B

SOUTHWESTERN LABORATORIES
SOURCE SAMPLING
ANALYTICAL DATA

Plant: Amoco Oil Co.
Texas City, Tx.

Box E (C) Run No. 3 Date: 5-4-89

PARTICULATES: Filter No. Bypass

Wt. Filter - Final
Wt. Filter - Tare
Wt. on Filter
Acetone Wash Particulate
Weight Partial Particulate (IMPP) g.

1st Impinger
2nd & 3rd Impinger
Impinger Catch-Total (IMPI) g.
Weight Total Particulate (GPC) g.

MOISTURE:

	Flask 1 (80% Isop)	Flask 2 (6% H_2O_2)	Flask 3
Impinger Wash H_2O Final Weight	147.4	289.4	
Initial Weight	147.4	269.1	
Net Increase	—	20.3	

Total Water Collected (TWW) 26.5 ml

Silica Gel No. 25
Final Weight 235.4
Initial Weight 229.2
Net Increase (TG) 6.2 g.
Vm(Std) 11.366 dscf

$$\% \text{ Moisture} = \frac{(0.04707 \times TWW) \times 100}{Vm\ (Std) + (0.04707 \times TWW)} = \frac{124.7355}{12.613355} = 9.9\%$$

ORSAT:

Time

CO_2				
O_2				
CO				

*Converted to ml by dividing by the density of water (1 g/ml)

MOLECULAR WEIGHT: (MWSG) g/g mole

H_2O	.099	x 18		= 1.782
CO_2	.901	x .050	x 44	= 1.9822
O_2	.901	x .020	x 32	= .5766
CO	—	x —	x 28	= —
N_2	.901	x .930	x 28	= 23.462

MWSG 27.80

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222 Cavalcade St. • PO. Box 8768. Houston. Texas 77249 • 713/692-9151

PROJECT: Amoco Oil Co Texas City, TX. SRU Jobs PROJECT NO.: _____

CALCD. BY: _____ DATE: _____ CHKD BY: JRD. DATE: 5-5-89

$\underline{N}\ Ba(ClO_4)_2 = \frac{1\,ml \times 0.10180\ \underline{N}}{11.45\,ml} = 0.00889\ \underline{N}$

Run/Imp.	Vf:	Aliquot	mls Titrant	Blk Corr. Titrant
1/1	96	5	4.00	4.00
"	"	5	4.00	
1/2	118	5	9.20	9.20
"	"	5	9.20	
1/3	105	10	0.70	0.70
"		10	0.70	
2/1	88	5	0.40	0.40
"	"	5	0.40	
2/2:3	214	5	7.50	7.53
"	"	5	7.55	
3/1	90	5	0.15	0.15
"	"	5	0.15	
3/2:3	220	5	7.50	7.50
	"	5	7.50	
80% Deep Blk.		5	<.05	<0.05
"		5	<.05	
6% H_2O_2 Blk.		5	<.05	<0.05
"		5	<.05	
0588-6091				
EPA QA		5	4.75	4.75
"	"	5	4.75	
3/2:3 spk.		4 + 1 spk	17.55	7.55
"	"	4 + 1 spk.	17.55	

spk = 0.10180 N H_2SO_4

AMOCO OIL COMPANY, TEXAS CITY, TEXAS -- SULFUR RECOVERY UNIT

Southwestern Laboratories
Environmental Analytical Services Division
Houston, Texas

SO2

Run No.	Lab Data: Titrant Volume (mLs)	Lab Data: Inp. Final V (mLs)	Lab Data: Aliq Vol (mLs)	Lab Data: Normality (N)	Lab Data: Dil Fact	Flow Inputs: Vm Std. (dscf)	Flow Inputs: % H2O	Flow Inputs: % O2	Flow Inputs: Qsd (dscf/hr)
1A	9.20	118	5.0	0.00889	1	11.366	12.53	2.2	1,599,306.0
1B	0.70	105	10.0	0.00889	1	11.366	12.53	2.2	1,599,306.0
2	7.53	214	5.0	0.00889	1	11.367	9.69	2.2	1,635,817.5
3	7.50	220	5.0	0.00889	1	11.346	9.90	2	1,639,234.5

E.P.A. Method 6
Sulfur Dioxide (SO2)
Calculations

Run No.	Conc. (lb/dscf)	ppm (dry)	ppm (wet)	ppm (02 free)	lb/hr
1A	1.199E-05	72.06	63.03	80.54	19.18
1B	4.059E-07	2.44	2.13	2.73	0.65
2	1.780E-05	106.95	96.59	119.54	29.11
3	1.826E-05	109.72	98.86	121.33	29.93

SOUTHWESTERN LABORATORIES, INC.
ORSAT FIELD DATA SHEET

PLANT: Amoco oil Co. Texas City, Tx.

SOURCE NAME: SRU Stack

DATE: 5-4-89

RUN NO: 1 TIME SAMPLED: 1206 - 1236 TIME ANALYZED: 1545 - 1605

CO_2	5.0	CO_2 = 5.0	CO_2	4.8	CO_2 = 4.8	CO_2		CO_2 =
$CO_2 + O_2$	7.2	O_2 = 2.2	$CO_2 + O_2$	7.0	O_2 = 2.2	$CO_2 + O_2$		O_2 =
$CO_2 + O_2 + CO$	—	CO = —	$CO_2 + O_2 + CO$		CO =	$CO_2 + O_2 + CO$		CO =

RUN NO: 2 TIME SAMPLED: 1308 - 1338 TIME ANALYZED: 1608 - 1632

CO_2	5.0	CO_2 = 5.0	CO_2	5.0	CO_2 = 5.0	CO_2		CO_2 =
$CO_2 + O_2$	7.2	O_2 = 2.2	$CO_2 + O_2$	7.2	O_2 = 2.2	$CO_2 + O_2$		O_2 =
$CO_2 + O_2 + CO$	—	CO = —	$CO_2 + O_2 + CO$	—	CO = —	$CO_2 + O_2 + CO$		CO =

RUN NO: 3 TIME SAMPLED: 1437 1507 TIME ANALYZED: 1635 1658

CO_2	5.0	CO_2 = 5.0	CO_2	5.0	CO_2 = 5.0	CO_2		CO_2 =
$CO_2 + O_2$	7.0	O_2 = 2.0	$CO_2 + O_2$	7.0	O_2 = 2.0	$CO_2 + O_2$		O_2 =
$CO_2 + O_2 + CO$	—	CO = —	$CO_2 + O_2 + CO$	—	CO = —	$CO_2 + O_2 + CO$		CO =

RUN NO: TIME SAMPLED: TIME ANALYZED:

CO_2		CO_2 =	CO_2		CO_2 =	CO_2		CO_2 =
$CO_2 + O_2$		O_2 =	$CO_2 + O_2$		O_2 =	$CO_2 + O_2$		O_2 =
$CO_2 + O_2 + CO$		CO =	$CO_2 + O_2 + CO$		CO =	$CO_2 + O_2 + CO$		CO =

DEFINITIONS

Standard Conditions: 68° and 29.92 inches of mercury

Stack Conditions: Stack temperature, pressure and moisture

NOMENCLATURE

ACFM	Volumetric stack gas flow in cubic feet per minute at stack conditions
AMT	Average temperature at meter in degrees Rankin
AN	Area of nozzle in square feet
As	Area of stack in square feet
C	Total pollutant concentration in grains per dry standard cubic feet
CFM	Cubic feet per minute
CO_2	Carbon Dioxide
CO	Carbon Monoxide
Cp	Pitot tube correction factor or (PTCF)
Cs	Partial pollutant concentration in grains or grams per dry standard cubic foot (total less impinger catch)
De	Equivalent stack diameter of rectangular stack

$$(De = \frac{2LW}{L+W})$$

DGMCF	Dry gas meter correction factor
DI	Deionized water
dscf	dry standard cubic feet
EA	Excess Air (expressed as percent)
°F	Temperature in degrees Fahrenheit
GPC	Grams of particulate caught (total)

NOMENCLATURE (Cont'd)

g	Grams
gr	Grains
Hg	Mercury
H_2O	Water
I	Isokinetics as percent
IMPI	Grams of particulate caught in impinger
IMPP	Grams of particulate caught before impinger (total less impinger catch)
MWSG	Molecular weight of stack gas in grams/gram-mole (g/g-mole) or pounds/pound-mole (lb/lb-mole)
N_2	Nitrogen
O_2	Oxygen
Pb	Barometric pressure in inches of mercury
Pm	Meter pressure in inches of mercury
ppm	Parts per million (Volume/Volume or mass/mass)
P_r	Barometric pressure of reference barometer
Ps	Absolute pressure in stack in inches of mercury
PMR	True pollutant mass rate in pounds per hour
PMRs	Pollutant mass rate for the "front half" in pounds per hour (total less impinger catch)
Qsd	Dry volumetric stack gas flow rate corrected to standard conditions in dscf/hr
°R	Temperature in degrees Rankin (equivalent to °F + 460°)
Std.P	Pressure at standard conditions (29.92 inches of mercury)

NOMENCLATURE (Cont'd)

Std.T	Temperature at standard conditions (528 °R)
TG	Total weight of water collected in silica gel, in grams
T_r	Temperature of reference thermometer
Ts	Stack gas temperature in degrees Rankin
T_t	Temperature of test thermometer
TWW	Total water wash volume collected in impingers and silica gel, in milliliters (ml) NOTE: Density of H_2O equals 1 g/ml
Vm (Std)	Total gas sampled converted to standard conditions, dry basis, in cubic feet
Vs	Stack gas velocity in feet per second
ΔH	Velocity head orifice reading in inches of water
ΔP	Stack gas velocity head in inches of water
θ	Sample time in minutes

SwL

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ENVIRONMENTAL SERVICES, HOUSTON, TEXAS

CONTROL UNIT CALIBRATION

BOX NO. Unit #3 DATE 1-16-89

DRY GAS METER NO. _____ Barometric Pressure, P_b 30.24 in. Hg

Orifice Manometer setting ΔH, in. H_2O	Gas Volume wet test meter V_w, ft^3	Gas Volume dry gas meter V_d, ft^3	Temperature: Wet Test Meter t_w, °F	Temperature: Dry Gas Meter Inlet t_{di}, °F	Temperature: Dry Gas Meter Outlet t_{do}, °F	Temperature: Dry Gas Meter Average t_d, °F	Time min.-sec.	Time θ min.	Y	ΔH@
0.25	3	362.535 / 365.469	74 / 74	72 / 86	76 / 80	78.5	10.21½	10.36	1.0304	1.6550
0.50	5	366.455 / 371.438	74 / 74	86 / 104	82 / 90	90.5	12.46	12.77	1.0330	1.7710
1.0	5	372.451 / 377.565	74 / 74	100 / 116	92 / 100	102	9.19½	9.325	1.0266	1.8500
2.0	10	378.595 / 388.988	74 / 74	116 / 132	98 / 108	113.5	13.26½	13.442	1.0283	1.8836
								Average	1.0296	1.7899

Calculations

ΔH	$\frac{\Delta H}{13.6}$	Y: $\frac{V_w P_b (t_d + 460)}{V_d \left(P_b + \frac{\Delta H}{13.6}\right)(t_w + 460)}$	ΔH@: $\frac{0.0317\ \Delta H}{P_b (t_d + 460)} \left[\frac{(t_w + 460)\theta}{V_w}\right]^2$
0.25	0.018	$\frac{3.00 \cdot 30.24 \times 538.5}{2.934 \cdot 30.26 \cdot 534}$	$\frac{0.0317 \times .25}{30.24 \times 538.5} \left[\frac{534 \cdot 10.36}{3.00}\right]^2$
0.50	0.037	$\frac{5.00 \cdot 30.24 \cdot 550.5}{4.983 \cdot 30.28 \cdot 534}$	$\frac{0.0317 \cdot .50}{30.24 \cdot 550.5} \left[\frac{534 \cdot 12.77}{5.00}\right]^2$
1.0	0.074	$\frac{5.00 \cdot 30.24 \cdot 562}{5.114 \cdot 30.31 \cdot 534}$	$\frac{0.0317 \cdot 1.00}{30.24 \cdot 562} \left[\frac{534 \cdot 9.325}{5.00}\right]^2$
2.0	0.147	$\frac{10.00 \cdot 30.24 \cdot 573.5}{10.393 \cdot 30.39 \cdot 534}$	$\frac{0.0317 \cdot 2.00}{30.24 \cdot 573.5} \left[\frac{534 \cdot 13.442}{10.00}\right]^2$

Is each ΔH@ within ±0.15 of $\overline{\Delta H@}$

__ yes, then $\overline{\Delta H@}$ is valid.

__ No, then repair and recalibrate.

Is each Y within ±0.02 of $\overline{Y}$

__ yes, then $\overline{Y}$ is valid.

__ No, then repair and recalibrate

SOUTHWESTERN LABORATORIES

Robbie Dwyer

SwL SOUTHWESTERN LABORATORIES

ENVIRONMENTAL SERVICES, HOUSTON, TEXAS
GAMMA CALIBRATION SHEET

PROJECT Amoco Oil Co · Texas City, Tx LAB NO.: 54-3905-253 DATE 5-5-89

BOX NO. 3
AVERAGE ΔH .50
MAXIMUM VACUUM 4 1/2
WET TEST GAS VOLUME: 1.00 FT^3
BAROMETRIC PRESSURE: 29.96 IN. Hg

CURRENT Y 1.0296
ACCEPTABLE Y LIMITS
.9781 TO 1.0811

DRY GAS METER VOLUME V_d FT^3	WET TEST METER t_w	TEMPERATURE DRY GAS METER INLET t_{di} °F	OUTLET t_{do} °F	AVERAGE t_d °F	Y
280.757 281.732	73	76 80	76 76	77	1.0320
281.732 282.709	73	80 84	76 78	79.5	1.0346
282.709 283.688	73	84 88	78 78	82	1.0373
			AVERAGE Y		1.0346

∴ Ready is read

$$\frac{V_w \; P_b \; (t_d + 460)}{V_d \; (P_b + \frac{H}{13.6}) \; (t_w + 460)} = Y$$

$\frac{1.00 \cdot 29.96 \cdot 537}{.975 \cdot 30.00 \cdot 533}$ = 1.0320

$\frac{1.00 \cdot 29.96 \cdot 539.5}{.977 \cdot 30.00 \cdot 533}$ = 1.0346

$\frac{1.00 \cdot 29.96 \cdot 542}{.979 \cdot 30.00 \cdot 533}$ = 1.0373

SOUTHWESTERN LABORATORIES

Robert Daigle

EES 01/81-19/801

CARL POE CO., INC. 99 REINERMAN ST. • HOUSTON, TEXAS 77007 • 713-861-3816

August 9, 1988

Southwestern Laboratories
P.O. Box 8768
Houston, TX 77249
Attn: R. Daughtery

Dear Sir:

This is to certify that your 150 Precision Wet Test Meter, Serial No. AB-3, has been calibrated with an American 10 Ft. Bell Prover, Serial No. 3157. It is traceable to the Bureau of Standards.

Reference No. 106870, PI-TAPE.

Test results are as follows:

IN-TEST Rate of Flow	% Error	OUT-TEST Rate of Flow	% Error
75 CFH	1.5%-	75 CFH	0.0%±

Sincerely,

CARL POE CO., INC.

Carl W. Poe

CWP:mv

SOUTHWESTERN LABORATORIES

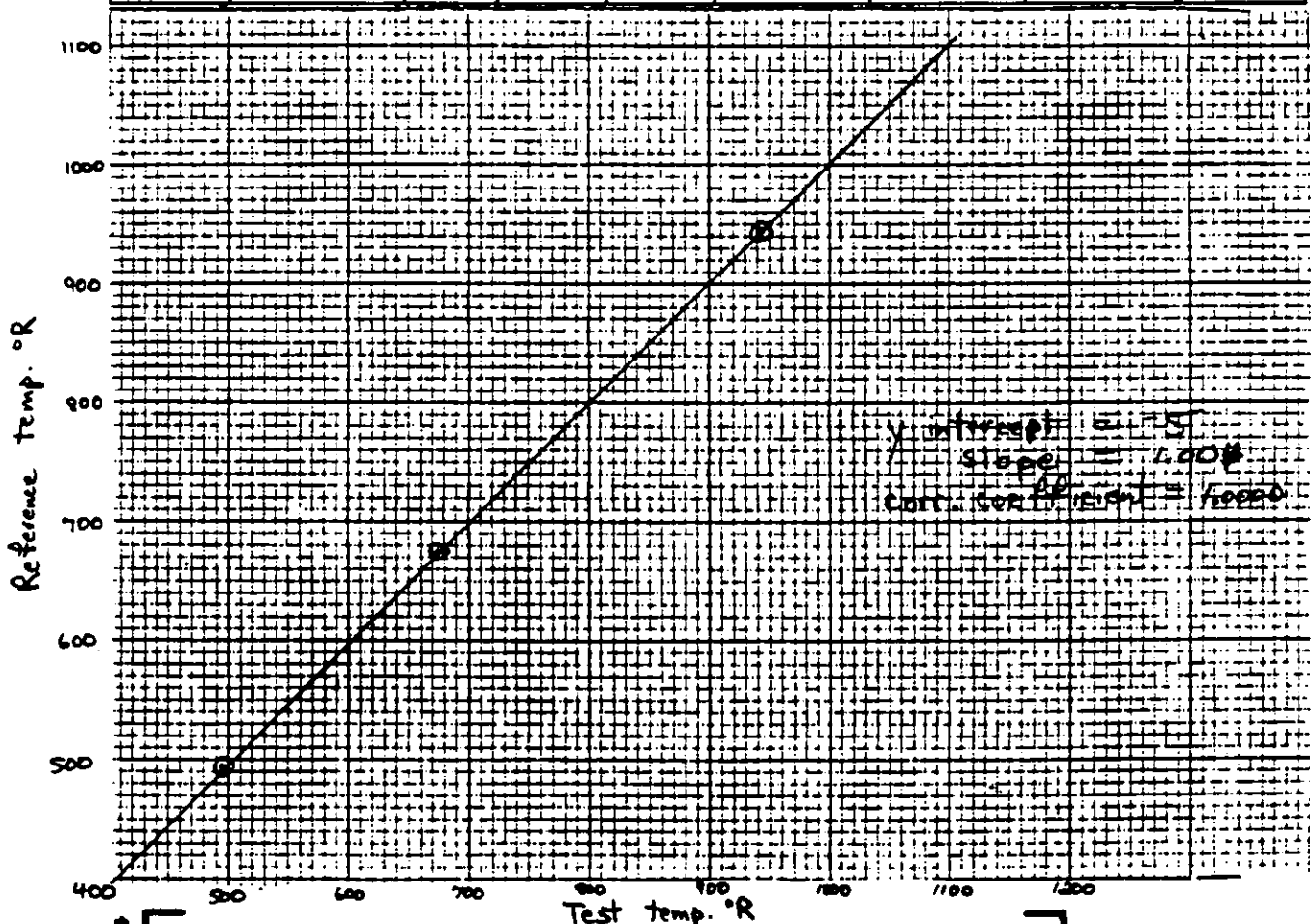
TEMPERATURE SENSOR CALIBRATION DATA

DATE: 9-23-82 THERMOCOUPLE NO.: 8-3

AMBIENT TEMPERATURE: 77 °F BAROMETRIC PRESSURE: 30.02 In. Hg

CALIBRATOR: M. Jones REFERENCE: Mercury-in-glass ASTM 3C

Reference Point Source	Reference Thermometer Temperature			Thermocouple Temperature		Temperature Difference*
	°C	°F	°R	°F	°R	%
Ice water	0	32	492	35	495	0.6
Boiling water	101	213.8	673.8	217	677	0.5
Boiling oil	249.7	481.5	941.5	483	943	0.2



* $\left[\frac{\text{(ref. temp., °F + 460)} - \text{(test thermom. temp., °F + 460)}}{\text{ref. temp., °F + 460}}\right]$ 100 ≤ 1.5% absolute valu

EES 10/82-05/817

THERMOMETER AND BAROMETER CALIBRATION

Project: Impact 0.1 cc **By:** Robbie Douglas

Project No: 54-8955-2.53 **Date:** 5-5-89

Thermometer	Thermocouple	Temperature °R (T_t)	Reference °R (T_r)*
Dorsey 37440	TC-8 3	532	531.6

*Mercury-in-Glass Thermometer

$$\% \text{ Difference} = \frac{T_t - T_r}{T_r} \times 100$$

$$\frac{532 - 531.6}{531.6} \times 100 = .075 \leq 1.5\% \therefore \text{READING IS VALID.}$$

Aneroid "Hg (P_b)	Reference "Hg (P_r)*
Barometer 3 29.99	29.96

*Mercurial Barometer

$$\text{Difference} = P_b - P_r$$

$29.99 - 29.96 = 0.02 \leq 0.1$ "Hg : READING IS VALID

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PROJECT: Pitot Tube Calibration PROJECT NO.: _____

CALCD. BY: _____ DATE: _____ CHKD BY: _____ DATE: _____

PITOT TUBE IDENTIFICATION NUMBER: 8-B DATE: 12-21-88

CALIBRATED BY: JRO 24" STD Pitot Tube, C_p std = 0.99

	"A" SIDE CALIBRATION			
RUN NO.	Δp_{std} cm H_2O (in. H_2O)	$\Delta p_{(s)}$ cm H_2O (in. H_2O)	$C_{p(s)}$	DEVIATION $C_{p(s)} - \bar{C}_p(A)$
1	.31	.49	.787	0
2	.31	.49	.787	0
3	.31	.49	.787	0
		$\bar{C}_p$ (SIDE A)	.787	

	"B" SIDE CALIBRATION			
RUN NO.	Δp_{std} cm H_2O (in. H_2O)	$\Delta p_{(s)}$ cm H_2O (in. H_2O)	$C_{p(s)}$	DEVIATION $C_{p(s)} - \bar{C}_p(B)$
1	.31	.49	.787	0
2	.31	.49	.797	0
3	.31	.49	.797	0
		$\bar{C}_p$ (SIDE B)	.797	

$$\text{AVERAGE DEVIATION} = \sigma(\text{A OR B}) = \frac{\sum_1^3 \left| C_{p(s)} - \bar{C}_p(\text{A OR B}) \right|}{3} \leftarrow \text{MUST BE} \leq 0.01$$

$$\left| \bar{C}_p(\text{SIDE A}) - \bar{C}_p(\text{SIDE B}) \right| \leftarrow \text{MUST BE} \leq 0.01$$

$$C_{Ps} = C_{p\,std} \sqrt{\frac{\Delta P_{STD}}{\Delta P_s}}$$

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PROJECT: $Ba(ClO_4)_2$ Standardization PROJECT NO.: _____

CALCD. BY: JRS/py DATE: 4-28-89 CHKD BY: _____ DATE: _____

	ml's. Titrant
Titration 1 :	11.40
2 :	11.50
	11.45 ml's Titrant Avg.

$$N\ Ba(ClO_4)_2 = \frac{1\ ml \times 0.10180\ N}{11.45\ ml's.}$$

$$= 0.00889\ N$$

41 ml's. D.I. H_2O

1 ml 0.10180 N H_2SO_4

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PROJECT: Amoco Oil Company PROJECT NO.: 8705-253

CALCD. BY: PM DATE: 5-5-89 CHKD BY: _____ DATE: _____

SO_2 TITRATION - EPA Q.A.

Ref. Sample #	Volume	Aliquot	Titrant	Blank Corr. Avg
0588-6091	5ml/100ml	5 ml	4.75 ml	4.75 ml
"	"	"	"	
6% H_2O_2	N.A.	5 ml	< 0.05ml	< 0.05ml
"	"	"	"	

Eq. 6-2: $$C_{SO_2} = \frac{32.03\,(V_t - V_{tb})\,N\,(Vol_{soln} / Vol_{al.})}{Vm_{std.}}$$

$$C_{0588-6091} = \frac{32.03\,(4.75ml)(0.00889\,N)(100/5)}{0.021}$$

$$= 1288.1\ mg/dscm \qquad \text{EPA Ref. Value} = 1296.0\ mg/$$

$$\%\ \text{Diff. From EPA Value} = \frac{1288.1 - 1296.0}{1296.0} \times 100$$

$$= -0.6\ \%$$

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PROJECT: Amoco O:I - SRU PROJECT NO.: 7905-253

CALCD. BY: PM DATE: 5-5-89 CHKD BY: _____ DATE: _____

SO_2 ANALYSIS - SPIKE RECOVERY

$$C_{spike} = \frac{(1\ ml)(0.10180\ N)}{5\ ml} = 0.02036\ N$$ ✓

$$C_{sample} = \frac{(7.50\ ml)(0.00889\ N)(4\ ml)}{5\ ml \times 5\ ml} = 0.01067\ N$$ ✓

$$C_{spk + spl.} = \frac{(17.55\ ml)(0.00889\ N)}{5\ ml} = 0.03120\ N$$ ✓

$$\%\ Recovery = \frac{0.03120\ N - 0.01067\ N}{0.02036\ N} = 100.8\ \%$$ * ✓

* TACB Allowable Limits : $90\% \leq X \leq 110\%$.

SOUTHWESTERN LABORATORIES
SOURCE SAMPLING CALCULATIONS

Run No: 1

Plant: Amoco Oil - SZ4
Texas City, TX

Date: 5-5-89

Hand Calculation Q.A Check of Computer Data.

SULFUR DIOXIDE

Impinger No. 2:

$$(Cso_2)_2 = \frac{7.061 \times 10^{-5} (Vt-Vtb)}{Vm\ (std)} \times N \times \frac{Vsoln.}{Va.} = \frac{7.061 \times 10^{-5} \times 9.20 \times 0.00889 N \times 118}{11.366 \times 5}$$

$$= 1.199 \times 10^{-5}\ lb/dscf$$

Impinger No. 3:

$$(Cso_2)_3 = \frac{7.061 \times 10^{-5} (Vt-Vtb)}{Vm\ (std)} \times N \times \frac{Vsoln.}{Va.} = \frac{7.061 \times 10^{-5} \times 0.70 \times 0.00889 \times 105}{11.366 \times 10}$$

$$= 4059 \times 10^{-7}\ lb/dscf$$

TOTAL CONCENTRATION OF SO_2

$Cso_2 = (Cso_2)_2 + (Cso_2)_3 = 1.199 \times 10^{-5} + 4.059 \times 10^{-7} = 1.240 \times 10^{-5}\ lb/dscf$

$$ppm\ SO_2 = \frac{Cso_2 \times 1.6014 \times 10^{10}}{2664.78} = \frac{1.240 \times 10^{-5} \times 1.6014 \times 10^{10}}{2664.78} = 74.49\ ppm\ (dry)$$

$$ppm\ SO_2\ (wet) = ppm\ SO_2\ (dry) \times \left(1 - \frac{\%H_2O}{100}\right) = N.A.$$

$$ppm\ SO_2\ (dry\text{-}O_2\ free) = ppm\ SO_2 \times \left(\frac{20.9}{20.9 - \%O_2}\right) = 74.49 \times \left(\frac{20.9}{20.9 - 2.2}\right) = 83.25\ ppm\ (dry,\ O_2\text{-}free)$$

$lb/hr\ SO_2 = Cso_2 \times Qsd = 1.240 \times 10^{-5} \times 1,599,3060 = 19.83\ lb/hr$

RUSSELL J. DIRAIMO, P.E., Manager
Environmental Services
Houston

Formal Education:

B.S. Civil and Environmental Engineering - University of Rhode Island - 1977

Additional Technical Education:

Texas A & M University- Cause and Prevention of Grain Elevator Fires and Explosions - 1978

Kansas State University - International Symposium on Grain Dust - 1979

Houston Building Owners and Managers Association, Inc. - "Controlling Exposure to Asbestos in the Office Environment" - 1985

The National Asbestos Training Center - University of Kansas "Practices and Procedures for Asbestos Control" - 1986

Industrial Hygiene & Safety Technology, Inc. - "Hazardous Waste Site Operations and Emergency Response", 29 CFR 1910.120. 40 hour training course, August, 1987.

Texas A & M Extension Course - "Asbestos Hazardous Emergency Response Act", 40 CFR 763 Subpart D, April, 1988. Certified Inspector; Certified Management Planner.

Professional Engineering Registration:

Texas

Certified Texas Air Control Board Visible Emissions Evaluator:

1978 to present

Awards and Honors:

Graduated High Distinction
Tau Beta Pi Honor Society
Phi Kappa Phi Honor Society

Professional Affiliations:

National Society of Professional Engineers (NSPE)
Texas Society of Professional Engineers (TSPE)
Air Pollution Control Association (APCA)
Source Evaluation Society
Water and Wastewater Analyst Association
Texas Hazardous Waste Management Society
National Asbestos Council

Since joining SwL in 1978, Russell has gained engineering experience with a concentration in civil and environmental applications.

As Manager of the Environmental Services Division, Mr. DiRaimo supervises the field and laboratory personnel which provide services including air pollution testing, personnel monitoring, water and wastewater analysis, hazardous waste characterizations, site contamination studies, and gas chromatography analysis. Mr. DiRaimo's responsibilities include personnel assignments, scheduling, data interpretation, calculations and report preparation.

Mr. DiRaimo has supervised environmental testing project for numerous municipal, industrial and petrochemical facilities including the Norco, Louisiana and Deer Park Texas facilities of Shell Oil Company, the Beaumont Specialty Chemicals Plant of Mobil Chemical Company, the Texas City, Texas facility of Amoco Oil Company, and the Houston, Texas facility of Hatheway Patterson Corporation.

PHILLIP W. YOKLEY, Environmental Scientist
Environmental Services
Houston

Formal Education:

B.S. - Environmental Health, East Tennessee State University - 1981

Additional Technical Education:

Asbestos Abatement Training Program, the University of Texas, Arlington, Texas - May, 1987.

Asbestos Technique Workshop, American Industrial Hygiene Association, Houston, Texas - April, 1987.

Identification of Asbestos Utilizing Polarized Light Microscopy, McCrone Research Institute, Chicago, Illinois - 1986.

In-Stack Opacity Monitor Audit Procedures, Environmental Protection Agency Regional Office, Annapolis, Maryland

Texas A & M Extension Course - "Asbestos Hazardous Emergency Response Act", 40 CFR 763 Subpart D, April, 1988. Certified Inspector; Certified Management Planner.

Certified Texas Air Control Board Visual Emissions Evaluator:

Since 1986

Professional Affiliations:

Air Pollution Control Association (APCA)
Source Evaluation Society

Since graduation, Phillip Yokley has gained an extensive background in the field of environmental monitoring, sampling and analysis. He began his career with the United States Department of Energy working in an industrial hygiene/safety capacity and subsequently held a position with coal-gasification wastewater treatment pilot facility. Most recently Mr. Yokley worked as an air pollution analyst for the Air Pollution Control Bureau in Pittsburgh, Pennsylvania.

Mr. Yokley joined SwL in 1985 as an environmental technician for the Environmental Services Division. He has subsequently been promoted to Senior Environmental Technician and Field Supervisor. His responsibilities include supervising field testing operations, equipment calibration, and the utilization of analytical instrumentation such as total organic carbon and total organic halogen analyzers necessary for the analysis of environmental samples. In addition, he is responsible for the identification and quantitation of asbestos content present in bulk samples as well as the determination of fibrous concentrations present in airborne samples.

JESSE ROBERT DAUGHTRY, Environmental Technician
Environmental Services
Houston

Additional Technical Education:

Texas Water Commission Wastewater Operator, Class D Certification, January 21, 1986.

Texas A&M University System, Wastewater Analysis, February 6, 1986.

Robbie Daughtry is a member of SwL's air pollution team and has participated and served as Field Supervisor in source testing for parameters such as particulates, sulfur oxides, volatile organics, nitrogen oxides, hydrogen sulfide and metals, Methodology includes those published by EPA and the Texas Air Control Board. Robbie is also a certified Visible Emissions Evaluator.

Robbie has also assisted in the preparation of samples for gas chromatographic analysis, and the sampling and analysis of water and wastewater samples.

8.13 BR ref 4 #8

DH

Letter covering the sampling + data

Amoco Oil Company
Post Office Box 401
Texas City, Texas 77592
409-945-1011

L.J. Sandheinrich
Refinery Manager

June 19, 1989

CERTIFIED NO.: P 882 515 693

R7-232

Mr. Herbert W. Williams
Regional Supervisor
Texas Air Control Board, Region 7
5555 West Loop South, Suite 300
Bellaire, Texas 77401

Amoco Oil Company, Texas City Refinery, Permit R-8811
Performance Test - Sulfur Recovery Unit Incinerator Stack

Dear Mr. Williams:

As required by Special Provision 4E of Permit R-8811, Amoco Oil Company, Texas City refinery submits the results from stack testing performed on the Sulfur Recovery Unit stack on May 4, 1989. This test was required to demonstrate operations with the IFP tail gas treater shut down and the gas routed to the SCOT tail gas treater.

The data indicate that the SRU incinerator emitted SO2 at a rate of 26.29 lb/hr during the test. This rate is well below the allowable rate of 161.9 lb/hr reflected in permit R-8811. Measured SO2 concentrations averaged 108 ppm, compared to the permit limit concentration of 250 ppm.

Sulfur production was 406 long tons/day for the May 4, 1989 test period. To compensate for the low sulfur production rate, the total production was routed through a single SCOT tail gas unit. Since both SCOT tail gas units are identical, this loading is the same as running two tail gas units while producing 812 long tons/day of sulfur. Therefore, the SO2 concentration measured at these test conditions is equivalent to what would be measured at a production rate of 812 long tons/day through both SCOT tail gas units. (406 long tons/day per SCOT unit). The SO2 emission rate would be twice the measured rate, or 52.58 lb/hr, which is below the allowable rate of 161.9 lb/hr reflected in permit R-8811.

8.13

If you have any questions concerning this test, please contact Ms. R. S. Edrozo, Engineer, Environmental Control, at (409) 945-1156.

Very truly yours,

L. J. Sandheinrich

L. J. Sandheinrich

Enclosures

Dr. E. R. Ibert
Director of Environmental Control Services
Galveston County Health District
P. O. Box 939
La Marque, Texas 77568

Mr. Eli Bell
Executive Director
Texas Air Control Board
6330 Highway 290 East
Austin, Texas 78723